

WHAT IS CLAIMED IS:

1. A silicon annealed wafer, on the surface of which a COP defect free layer having a thickness of 5 μm or more is formed by annealing a base material wafer, wherein said base material wafer includes:
 - a COP defect region of a single crystal containing nitrogen at a concentration of less than 1×10^{14} atoms/ cm^3 , wherein said COP defect has a size of 0.1 μm or less in the highest frequency of occurrence and there exist no COP defects having a size of more than 0.2 μm ;
 - oxygen precipitates formed at a density of 1×10^4 counts / cm^2 or more when said base material wafer is subjected to a oxygen precipitate evaluation heat treatment; wherein
 - the ratio of the maximum to the minimum of BMD (oxygen precipitate) density is 3 or less in the radial direction of said base material wafer.
2. A silicon annealed wafer according to Claim 1, wherein the oxygen concentration of said base material wafer is $11 \times 10^{17} - 17 \times 10^{17}$ atoms/ cm^3 (ASTM F-121, 1979).
3. A silicon annealed wafer according to Claim 1, wherein said COP defect occurrence region extends over an 80% or more surface area of said base material wafer in the radial direction.
4. A silicon annealed wafer according to one of Claims 1 to 3, wherein the annealing process is performed at 1100°C – 1250°C for 1 – 4 hours in a hydrogen gas, argon gas, helium gas or a mixed gas thereof.
5. A silicon annealed wafer, on the surface of which a COP defect free layer

having a thickness of 5 μm or more is formed by annealing a base material wafer, wherein

said base material wafer contains nitrogen at a concentration of less than 1×10^{14} atoms/cm³, and

said base material wafer is grown by the Czochralski method under the following conditions:

the temperature gradient ratio G_c/G_e is 1.0 – 1.5 where G_c ($^{\circ}\text{C}/\text{mm}$) and G_e ($^{\circ}\text{C}/\text{mm}$) are averaged temperature gradients in the axial direction of pulling at a temperature range from 1370 $^{\circ}\text{C}$ to 1310 $^{\circ}\text{C}$ for the center and the outer periphery of said base material wafer, respectively;

the cooling time from 1200 $^{\circ}\text{C}$ to 1000 $^{\circ}\text{C}$ is within 50 min; and

the cooling time from 1030 $^{\circ}\text{C}$ to 920 $^{\circ}\text{C}$ is within 30 min.

6. A silicon annealed wafer according to Claim 5, wherein the oxygen concentration of said base material wafer is $11 \times 10^{17} - 17 \times 10^{17}$ atoms/cm³ (ASTM F-121, 1979).

7. A silicon annealed wafer according to Claim 5 or 6, wherein the annealing process is performed at 1100 $^{\circ}\text{C}$ – 1250 $^{\circ}\text{C}$ for 1 – 4 hours in a hydrogen gas, argon gas, helium gas or a mixed gas thereof.

8. A silicon epitaxial wafer produced by forming an epitaxial layer on the surface of a base material wafer,

wherein said base material wafer includes:

a COP defect occurrence region of a single crystal containing nitrogen at a concentration of less than 1×10^{14} atoms/cm³, wherein said COP defect has a size of 0.1 μm or less in the highest frequency of occurrence and there exist no COP defects having a size of more than 0.2 μm ;

oxygen precipitates formed at a density of 1×10^4 counts /cm² by

applying a oxygen precipitate evaluation heat treatment; wherein
the ratio of the maximum to the minimum of BMD (oxygen precipitate)
density is 3 or less in the radial direction of said base material wafer.

9. A silicon epitaxial wafer according to Claim 8, wherein the oxygen
concentration of said base material wafer is $11 \times 10^{17} - 17 \times 10^{17}$ atoms/cm³
(ASTM F-121, 1979).

10. A silicon epitaxial wafer according to Claim 8, wherein said COP defect
occurrence region extends over an 80% or more surface area of said base
material wafer in the radial direction.

11. A silicon epitaxial wafer produced by forming an epitaxial layer on the
surface of a base material wafer,
wherein said base material wafer contains nitrogen at a concentration
of less than 1×10^{14} atoms/cm³, and

said base material wafer is grown by the Czochralski method under
the following conditions:

the temperature gradient ratio G_c/G_e is 1.0 – 1.5 where G_c (°C/mm)
and G_e (°C/mm) are averaged temperature gradients in the axial direction
of pulling at a temperature range from 1370°C to 1310°C for the center and
the outer periphery of said base material wafer, respectively;

the cooling time from 1200°C to 1000°C is within 50 min; and

the cooling time from 1030°C to 920°C is within 30 min.

12. A silicon epitaxial wafer according to Claim 11, wherein the oxygen
concentration of said base material wafer is $11 \times 10^{17} - 17 \times 10^{17}$ atoms/cm³
(ASTM F-121, 1979).